The Taxation of Foreign Profits: a Unified View *

MICHAEL P.DEVEREUX†, CLEMENS FUEST‡, AND BEN LOCKWOOD§

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Abstract

This paper synthesizes and extends the literature on the taxation of foreign source income in a framework that covers both greenfield and acquisition investment, and a general constraint linking investment at home and abroad for the multinational by introducing a cost of adjustment for the mobile factor. Unless the cost of adjustment is zero, the domestic tax on foreign-source income should always be set to ensure the optimal allocation of the mobile factor between domestic and foreign assets and should follow the classical rules in the literature; national optimality requires the deduction rule, and global optimality requires the credit rule. Only in the zero-cost case does exemption become optimal. Allowances can be set so as to ensure that domestic and foreign asset purchases are undistorted by the tax system: this requires a cash-flow tax on domestic investment in the greenfield case, and a cross-border cash flow tax on foreign investment in both cases. These basic results extend to various extensions of the model, notably (i) when a profit-shifting motive is present; (ii) to some extent, when a corporate income tax is in place. The introduction of tax administration costs into the model can explain the empirical trend towards use of the exemption regime.

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†Centre for Business Taxation, Said Business School, University of Oxford, Park End Street, Oxford OX1 HP, UK. Email: michael.devereux@sbs.ox.ac.uk

‡Centre for European Economic Research (ZEW), Mannheim, Germany, and CBT. Email: fuest@zew.de

§CBT, CEPR and Department of Economics, University of Warwick, Coventry CV4 7AL, UK. Email: B.Lockwood@warwick.ac.uk

1 Introduction

For many years tax policy in the US as well as the UK seemed at least partly to follow the logic of conventional international tax theory by taxing foreign source income according to the tax credit system, although both limited the size of the tax credit. Other countries like Germany and France, however, chose to exempt foreign source income fully or almost fully from domestic taxation. But in one of the most striking trends in corporate taxation in recent years, there has been a significant switch to exempting foreign-source income from taxation. According to PwC Worldwide Tax Summaries, out of 37 high-income countries, 19 had an exemption system in 1998, rising to 27 in 2008[1]. None of these 37 countries switched from exemption to a credit or other system during this period.

This trend appears to conflict with classical results in the theory of international taxation, which states that countries should tax the foreign source income of multinational firms according to the foreign tax credit system to make sure that the allocation of capital in the world economy is undistorted (Richman, 1963). This result is based on the idea that, under the foreign tax credit system, firms will ultimately pay the same tax, irrespective of the investment location, so that their location choices are not distorted if corporate tax rates differ across countries,[2] achieving so-called capital export neutrality (CEN).

However, the "old" view that the exemption system is inferior to the tax credit system has been challenged by Desai and Hines (2003, 2004). Their main argument is that a large part of international investment nowadays takes the form of mergers and acquisitions, a type of investment largely neglected by the "old" view. They emphasize the fact that mergers and acquisitions investment, implies a change in *ownership*, rather than the location of physical capital. But the ownership of assets is distorted if different potential owners, who are located in different countries, are taxed differently. Desai and Hines argue that capital ownership neutrality (CON) requires that all potential owners of an asset face the same tax burden, irrespective of their country of residence, and that this requires an exemption form tax of foreign source income.[3]

Becker and Fuest (2010) extend and refine Desai and Hines' argument by observing that once a multinational has made an acquisition, it also faces the problem of how to allocate a scarce resource between the existing company and the new acquisition. They consider two polar cases. They find that the exemption system is optimal from a national as well as a global perspective if foreign acquisitions of multinational firms do not affect domestic activities. But they argue that in the opposite polar case, when the number of acquisitions abroad reduces the number at home one-for-one, exemption is no longer optimal: it leads to overinvestment in the low tax country and underinvestment in the high tax country. Moreover, in this case, neither the tax credit system nor the full taxation after deduction system can restore global or national optimality[4].

There is no doubt that the "new view" of taxation of foreign-source income in an environment in which FDI takes the form of acquisitions is an important step forward. But existing papers are based on rather different assumptions regarding the corporate tax system under consideration, the impact of

[1] We thank Johannes Voget for providing us with this data-set.

[2] A second key result in the theory of international taxation states that, from a national perspective, it is optimal to tax foreign source income according to the full taxation after deduction principle (Feldstein and Hartman, 1979). However, this leads to a suboptimal outcome from a global point of view.

[3] The term capital ownership neutrality was introduced by Devereux (1990) in a slightly different context.

[4] Becker and Fuest (2010) show that national optimality can be achieved in this case by allowing the firm to deduct the cost of the acquisation against tax in the first period, and then applying the deduction rule to foreign-source income in the second period. This result is a special case of our Proposition 2 below.

foreign investment on domestic economic activity and the type of foreign investment - greenfield versus acquisitions. This makes it difficult to draw systematic conclusions for purposes of tax policy. This paper attempts to reconcile and extend the different results and approaches in the literature by analyzing the optimality of taxes on foreign source income in a model which encompasses most of the models in the literature, both "new" and "old".

Our model extends the literature in several ways. Firstly, existing models usually take the tax base as given and focus on tax rates. Instead, we consider the design of tax rates and tax bases simultaneously, and we show that this is of key importance for understanding the optimal taxation of foreign source income. Secondly, we develop a model which includes both greenfield and acquisition investment as special cases. Thirdly, rather than assuming that foreign investment either reduces domestic investment one-for-one or does not affect domestic investment at all, our approach also includes intermediate cases, as is explained further below.

In our model, foreign investment by a domestic multinational firm is in two steps. The first is the purchase of an immobile asset in the foreign country, initially owned by a foreign household, and can be understood as choosing the *location* of production. This asset may be interpreted as a piece of land or an existing firm. Following Desai and Hines (2003) and Becker and Fuest (2010), we allow for the multinational to have an ownership advantage relative to the seller i.e. it can produce more output from the asset.[5] Conceptually, the only difference between greenfield and acquisition investment is that the foreign corporate tax rate is capitalized into the price of the firm, but not into the greenfield asset. This brings out the central role of tax capitalization very clearly, in contrast to other models, where greenfield investment is often viewed as the allocation of capital to a production function. Of course, there may be other differences between greenfield and acquisition investment - in particular, they may create different spillovers for the host country, and we consider this extension in Section 5.4.

The second step is to combine the immobile asset with a continuously variable, internationally mobile, factor of production, and can be understood as choosing the *scale* of production. The recent literature on the taxation of foreign profits has shown that it is of central importance whether foreign investment affects domestic economic activity, and we allow for this in a simple and empirically relevant way, by means of introducing a *cost of adjustment* for the mobile factor. Specifically, the multinational has an initial stock of the mobile factor, which it can allocate to assets at home or abroad. But, in addition, it can hire additional amounts of the mobile factor, at the cost of incurring a convex cost of adjustment in addition to the market price of the factor. In the limiting case where this cost of adjustment is zero, there is no link between domestic and foreign production (Becker and Fuest's "variable management capacity"). In the other limiting case where the adjustment cost becomes very large, there is a one-to-one trade-off between domestic and foreign projects (Becker and Fuest's "fixed management capacity").

We first consider the case where governments can choose the tax rate and the tax base, including the size of the initial allowance. This brings out the main features very clearly. In the general case where there is some positive cost of adjustment of the mobile factor, our main findings are as follows. The government has two kinds of instrument; the statutory tax rate on foreign-source income, and allowances on domestic and foreign asset purchase. It turns out that for both national and global optimality, there is a simple and robust assignment of instruments to targets. First, the domestic tax rate on foreign-source

[5] We follow these contributions in abstracting from residence based taxes on capital income at the personal level. In the context of taxing foreign source income the role of these taxes is discussed in Becker and Fuest (2011), Devereux (2000, 2004), Gordon (2011), Ruf (2009) and Wilson (2011).

income should be set to ensure the optimal allocation of the mobile factor between domestic and foreign assets. The setting of the tax rate follows the classical rules in the literature; national optimality requires the deduction rule, and global optimality requires the credit rule. Second, the initial allowances should be set so as to ensure that domestic and foreign asset purchases are undistorted by the tax system. This requires a cash-flow tax on domestic investment[6], and a *cross-border cash flow tax* on foreign investment.[7]

Implementation of a cash flow tax on domestic or outbound flows is relatively straightforward: in either case all real expenditure would be deductible from the tax base, and the corresponding income would be taxed at the same rate. However, there is a difference in the required tax rate. For national optimality, the deduction rule implies that the cross-border cash flow tax should be set at the same rate as the domestic tax. But global optimality requires the rate of the cross-border cash flow tax to depend on the tax rate of the foreign country - that is, on the destination of the outbound investment. In practice this would give an incentive for firms to route investment through a high tax country, and governments would need anti-avoidance rules to prevent this.

It may be objected that our model, taken literally, predicts that all countries should choose something other than an exemption regime; that is, that they should levy some positive tax on foreign source income. A first explanation of why we instead see a trend towards exemption systems, which we address in Section 4.4, is the cost of tax administration; it seems reasonable to suppose that an exemption system has a lower cost of administration. If the cost of moving skilled labour or capital between different subsidiaries of a multinational is also falling over time, our model predicts that the efficiency loss from choosing exemption would also fall, explaining an increasing use of the exemption system.

A second possible explanation for the increasing use of exemption systems is that parent companies of multinational corporations may find it possible to move their residence for tax purposes (although they may face a tax charge in doing so). We do not address the incentive to switch the location of the parent company, although our model could be extended in this direction. With this additional feature, it is intuitively clear that the greater the mobility of the parent, the lower would be the optimal tax rate on foreign source income. Further, if this mobility is increasing over time, then this could also help explain the trend towards exemption.

Our analysis includes a number of extensions of the baseline model. Here, we mention two of the most important ones. First, we show that our results also hold in a variant of our model where the multinational can engage in profit shifting by manipulating transfer prices. It turns out that the credit rule does double duty in this case: it ensures globally efficient allocation of managerial capacity, *and* eliminates incentives for transfer-pricing[8]. This result holds whether or not the costs of transfer-pricing (for example, tax advice) are deductible from the corporate tax.

Second, we analyze the case where the tax base is the full income of the firm, after depreciation but before financing costs. If depreciation costs and financing costs for both debt and equity were allowed against tax, as under the ACE (allowance for corporate equity), then the tax would be equivalent in present value terms to a cash flow tax. In modelling an income tax we therefore do not allow financing costs to be deductible. This removes one instrument available to the government, and generally means that a first-best solution is no longer feasible. In this setting, we consider a second best setting of the

[6] A qualification is that in the aquisitions case, no allowance should be granted as the aquisition price is already adjusted by the corporate tax rate.

[7] This was first pointed out by Keen (1993).

[8] Under a weak additional assumption, the deduction rule also induces nationally optimal transfer pricing for the host country of the multinational.

tax rate on foreign source income, and show that the second-best globally optimal tax rate depends on (i) whether or not the home statutory rate is greater or lower than the foreign rate, and (ii) the relative sensitivity of the cost of domestic and foreign investment to the tax rate. In particular, the credit system does not always dominate the exemption system, but it does so when sensitivities are the same and the foreign statutory rate is higher than the domestic rate.

Other extensions are as follows. First, while our baseline model assumes that the interest rate in the capital market is given, we analyze how our results are affected if we close the model and endogenize the interest rate. Our results for global optimality do not change. In the case of national optimality, however, countries may have an incentive to change the interest rate, depending on whether they are capital exporters or capital importers, so that the nationally optimal tax policy may be distorted. Second, we explore the impact of taxing foreign source income only when it is repatriated to the home country. In line with the "new view" of dividends, we show that the investment from earnings retained abroad does not depend on the home country taxation of foreign source income. Third, we examine the case of competition amongst acquirers, which allows the owners of the target company to capture part of the surplus generated by an acquisition. Again we show that our results are unaffected. Fourth, we allow for positive spillovers of activity by the multinational company in the foreign country. This does not affect national optimality for the home country, since the spillovers accrue to foreign residents. We show that global optimality requires a modification of the cross-border cash flow tax, with higher allowances being required to promote additional outbound investment.

The rest of the paper is set up as follows. Section 2 briefly discusses the previous literature. Section 3 presents the model. In section 4 we analyze the optimal taxation on foreign source income for the different variants of our model. Section 5 explores our various extensions of the baseline model. Section 6 concludes.

2 Related Literature

We organize the discussion by first focussing on the polar case of unlimited management capacity. Desai and Hines (2003, p. 496) for the most part assume that domestic capital stock is unaffected by foreign acquisitions, corresponding to our special case of unlimited management capacity[9]. In this case, they have three claims. First, they claim that national optimality requires exemption: '*National welfare is maximized by exempting foreign income from taxation in cases in which additional foreign investment does not reduce domestic tax revenue raised from domestic economic activity.*' (Desai and Hines, 2003, p. 496). Second, they claim that exemption is also sufficient for global optimality, i.e. CON: *"CON is satisfied if all countries exempt foreign income from taxation"* (Desai and Hines, 2003, p. 494). Third, they say that exemption is not necessary for CON, as a tax credit system will also work: *"if all countries tax foreign income (possibly at different rates), while permitting taxpayers to claim foreign tax credits, ..(this meets).. the requirements for CON"* (Desai and Hines, 2003, p. 494). Turning to Becker and Fuest (2010), in the case of unlimited management capacity, they find that the exemption system is optimal from a national as well as a global perspective if foreign acquisitions of multinational firms do not affect domestic activities (Proposition 3 in their paper). Our results for unlimited management capacity generalize and clarify

[9] Specifically, they assume that "the total stock of physical capital in each country is unaffected by international tax rules" (p494).

these claims: we show that with a cash-flow tax, *any* tax on foreign-source income is optimal from a global perspective, *not just a tax of zero (exemption) or a tax equal to the difference between domestic and foreign corporate tax rates (credit).*

Desai and Hines have relatively little to say about nationally and globally optimal tax rules when national capital stocks respond to tax differences: in this case, they say that *"the welfare implications of CON are less decisive"* (Desai and Hines, 2003, p. 494). Becker and Fuest (2010) consider the polar case where foreign acquisitions reduce domestic investment one-for-one. They also consider a cross border cash flow system, as we do, and find that this system leads to national but not to global optimality. We find that a cross-border cash flow system also generates global optimality; the difference between the two results is explained by the fact that Becker and Fuest (2010) impose the condition that the tax rate of the cross border cash flow tax has to be the same as the domestic corporate income tax.

Our main contribution in this paper, relative to the literature, however, is to characterize optimal tax rules in the general case where management capacity is limited, but not fixed. In this case, we show that the optimality of the exemption rule is not robust; national and global optimality of exemption *only holds in the knife edge case where the impact of foreign investment on domestic activity is exactly zero.* As soon as there is a small but positive adjustment cost, deduction is nationally optimal, and credit is globally optimal.

Another related paper is Wilson (2011). In his model foreign acquisitions may increase or decrease the productivity of domestic activities of multinational firms. While his model differs from ours in various respects, one important difference is that foreign taxes are always deductible from taxable foreign source income. We do not make this assumption.[10] Given this, he asks whether domestic taxes should be positive. His main result is that exemption is usually not optimal.

Another insight generated by our analysis is that many results for the optimal taxation of foreign profits in the presence of acquisitions investment that have been derived in the literature are driven by assumptions on the tax base, rather than underlying factors like differences between acquisitions and greenfield investment or the impact of foreign investment on domestic investment as such. In an extension of our baseline model, we show this by assuming that the tax base is as in a typical income tax system, where tax depreciation is equivalent to economic depreciation and no relief is given for the cost of finance. In general in this setting, it is not possible to achieve the first best, since the tax drives up the cost of capital leading to underinvestment. The optimal treatment of the mobile factor depends on whether the costs of using that factor are fully deductible from tax. If so, then the usual rules apply to the tax rate: national optimality requires a deduction system, and global optimality requires a credit system. If not, then these rules apply not to the tax rate, but to the rate of relief given, since this is what determines the international allocation of this factor.

3 The Model

3.1 Overview

There are two countries, home and foreign, and two periods. A single multinational (MNC) is based in the home country. In the first period, the MNC can purchase assets either in the home or foreign

[10] Gordon (2011) also analyses optimal taxes on foreign source income but focuses on income shifting between corporate profits and wages of employees.

country. An asset can be either a greenfield site or an existing company, as explained in more detail below. Output can be produced by combining this asset with a factor of production, which we call management capacity, following Becker and Fuest (2010), but which could be interpreted as capital. This factor can be purchased on an international market at a fixed price w. Each asset requires one unit of management capacity, plus one unit of local labour, to produce output in the second period. The MNC has a fixed initial stock of management capacity, M_0, which can be costlessly allocated between home and foreign activities. In addition, the MNC can hire h, h^* additional managers on the international market to work either at home or in the foreign country. Hiring h, however, incurs convex costs of adjustment, $c(h)$. This nests the two special cases that have so far been considered in the literature. Specifically, $c \equiv 0$ is the case of completely variable management capacity, and $c \to \infty$ is the case of completely fixed management capacity. The adjustment cost function is discussed in more detail below.

3.2 Assets and Outputs

In the case of greenfield investment, we assume that there are number - technically, a continuum - of different possible domestic and foreign investment projects, indexed by Δ, $\Delta^* \in [0,1]$ respectively.[11] In the case of greenfield investment, Δ, Δ^* are the outputs from the domestic and foreign projects respectively. In the case of acquisition investment, we assume that the initial owner of the asset - a home or foreign firm - can produce v, v^* respectively using one unit of management. Following Becker and Fuest, as well as much existing literature on MNCs, we assume that the MNC has some comparative advantage in management, or other fixed factor, so that when a national domestic (foreign) firm is acquired by the MNC, its output is boosted by Δ (resp. Δ^*). So, when owned by the MNC, revenues from the domestic and foreign firms are $v + \Delta$, $v^* + \Delta^*$ respectively.

3.3 Asset Prices

Generally, we denote the price of the domestic and foreign assets by P, P^* respectively; this is the price paid by the MNC in the first period if the asset is bought. In the case of greenfield investment, we assume that the MNC can acquire the asset (e.g. land) at its opportunity cost. This cost can be interpreted as what can be produced from the land in its alternative use e.g. farming, and we denote the costs as C, C^* in the home and foreign countries respectively. So, in this case,

$$P = C, \; P^* = C^*. \tag{1}$$

We make a similar assumption in the case of acquisition investment i.e. that the MNC can acquire the foreign target at its private opportunity cost, which in this case is the after-tax profit which the target firm could have made, which is $(v - w)(1 - \tau)$ for the home target, and $(v^* - w)(1 - \tau^*)$ for the foreign target. This assumption is relaxed in Section 4.1 below. So, in this case,

$$P = (v - w)(1 - \tau)/(1 + r), \; P^* = (v^* - w)(1 - \tau^*)/(1 + r). \tag{2}$$

[11] An interesting question for tax purposes is whether profits generated by a foreign investment project are based on domestic assets of the multinational firm like particular know-how, for instance. If so, one could argue that royalties should be paid to the parent company, to make sure that the income generated by domestic assets is also taxed domestically. In the following we abstract from this issue. Including it would require a broader discussion of international income shifting, which is not the focus of this paper.

Note the key difference between greenfield and acquisition assets; in the latter, the corporate tax is capitalized into the price, whereas in the former, it is not[12]. In our framework, this is the *only* substantive difference between greenfield and acquisition investment, and it is this that drives the differences in the results below[13]. Finally, note that if the revenue or profit produced from land in its alternative use is subject to corporate tax, then $P = C(1-\tau)$, $P^* = C^*(1-\tau)$, and there would be no substantive difference between greenfield and acquisition investment.

3.4 The Multinational

With either greenfield or acquisition investment, the MNC will purchase a domestic asset if and only if the productivity of the asset is above some cutoff $\hat{\Delta}$. Similarly, the MNC will purchase a foreign asset if and only if the productivity of the asset is above some cutoff $\hat{\Delta}^*$. The number of managers required to run domestic operations is therefore $1-\hat{\Delta}$, and similarly, the number of managers required to run foreign operations is $1-\hat{\Delta}^*$. The number of new hires that the MNC makes in its domestic and foreign operations is then

$$h = 1 - \hat{\Delta} - (M_0 - M^*), \; h^* = 1 - \hat{\Delta}^* - M^* \tag{3}$$

where M^* is the number of its M_0 existing managers the MNC costlessly allocates to its foreign subsidiary. Of course, h, h^* can negative, in which case they have the interpretation of reductions in the initial managerial workforce.

Following a well-known literature in labour economics (Hamermesh and Pfann, 1996), we suppose that there are costs $c(h), c^*(h^*)$ of adjusting the managerial workforce. For $h, h^* > 0$, these will be the costs of hiring and training. For $h, h^* < 0$, these will be the legal and organizational costs of reducing the existing workforce. We consider two possible cases. The first is the limiting case of no adjustment costs i.e. the following assumption holds:

NC: $c(h) \equiv c^*(h^*) \equiv 0.$

The second is where adjustment costs are positive, in which case, we assume standard regularity conditions on adjustment costs; namely, the adjustment cost function is twice continuously differentiable, strictly convex, and strictly increasing in h, h^* :

C: $c'(h), c^{*\prime}(h^*) > 0, \; h, h^* \neq 0, \; c''(h), c^{*\prime\prime}(h^*) > 0, \; c'(0), c^{*\prime}(0) = 0$

These conditions are satisfied, for example, by the quadratic adjustment cost functions $\frac{\alpha}{2}h^2$, $\frac{\alpha^*}{2}(h^*)^2$, $\alpha, \alpha^* > 0$. We also assume that along with wages, these costs are fully deductible from the tax base.

Given the above, second-period domestic and foreign cash-flows of the firm are

$$\begin{aligned} \Pi &= \int_{\hat{\Delta}}^{1} (v + \Delta - w)d\Delta - c(h) \\ \Pi^* &= \int_{\hat{\Delta}^*}^{1} (v^* + \Delta^* - w)d\Delta^* - c^*(h^*) \end{aligned} \tag{4}$$

[12] Shafik et al. (2011) study the impact of taxation on foreign acquisitions of German multinational companies and find evidence that host country taxes are partly capitalised in the purchase price.

[13] It is of course, possible that the land purchased by a multinational is already utilized in a taxable activity, in which case, even this difference disappears.

where, in the case of greenfield investment, it is understood that $v = v^* = 0$.

Second period cash-flow Π is taxed at rate τ by the home government. Second period cash-flow Π^* is taxed at rate τ^* by the foreign government and at rate τ^f by the home government.

We do not explicitly permit a deduction for the cost of finance or depreciation in the second period. Instead we model first period allowances as proportional to the asset purchase prices. These allowances can be interpreted as the present value of deductions for interest and depreciation arising in either period. Below we consider in particular a cash flow tax in which the value of the allowance is equal to the tax rate. As is well known, this can be achieved by a cash flow tax which allows a deduction in the first period for the entire cost of asset purchases, but no deduction for the cost of finance. However, the allowances could also be interpreted as relief for true economic depreciation as well as the cost of finance. For simplicity our discussion is based on the cash flow approach, where finance is raised from new equity, given by:

$$E = (1 - \hat{\Delta})(1 - a)P + (1 - \hat{\Delta}^*)(1 - a^f - a^*)P^* \tag{5}$$

where a, a^f are the shares of the purchase prices P, P^* respectively that can be set against domestic corporate tax, and a^* is the share of the purchase price P^* that can be set against foreign corporate tax.

The MNC makes three choices; it chooses $\hat{\Delta}, \hat{\Delta}^*, M^*$.

3.5 Relationship to the Existing Literature

This set-up encompasses most existing contributions to the study of rules for taxation of foreign-source income. First, the original Feldstein-Hartman(1979) set-up can be thought of as a special case where (i) there are no asset purchase decisions i.e. the MNC has already decided on the number of plants at home and abroad i.e. $\hat{\Delta}$, and $\hat{\Delta}^*$; (ii) the only decision is now to allocate a fixed stock of the factor of production (capital in their model) between the domestic and foreign plants. In turn, the case of a fixed stock of capital is a limiting case of this set-up where the cost of adjustments to the capital stock become infinite i.e. $c, c^* \to \infty$. The model of Becker and Fuest (2010) is also a special case of this one, where (i) investment can only be acquisition, not greenfield, and (ii) the variable factor of production (management capacity in their case) is either completely fixed or completely variable i.e. either assumption NC holds, or assumption C holds, with $c, c^* \to \infty$.

There are many extensions of Feldstein-Hartman (1979) set-up, but most of these share the common feature that they do not explicitly model asset acquisition across borders. Investment decisions are (implicitly) made by households, who rent or sell capital to domestic firms who are *already established* in each country: there are no multi-nationals. For example, Horst (1980) allows the supply of capital (assumed fixed in both countries in Feldstein-Hartman (1979)) to be elastic. Keen and Piekkola (1997) extend the Horst framework to allow for a government budget constraint, and also allow home and foreign governments to set domestic distorting taxes and also lump-sum taxes. Slemrod et al.(1997) study an extension of Feldstein-Hartman (1979) where there is both inward and outward investment, and Devereux (2004) extends this to the case of simultaneous portfolio and direct investment flows. Some of the ground covered by these papers is also covered in our extensions: for example, in Section 5.4.1, we study the case where the supply of both capital and managerial capacity is endogenous.

Other related literature includes recent contributions on the taxation of outward investment where multinationals are modelled, and which consider the choice between FDI and exports as modes of serving the foreign market. Devereux and Hubbard (2003), which studies an environment where the home firm competes in the foreign market with a competitor firm located in a third country. For the firm, there is no link between domestic production and either export or FDI, as in this paper i.e. in the language of Becker and Fuest (2010), there is unlimited management capacity. Devereux and Hubbard (2003) and Becker (2013) also study tax rules where firms can choose between exports and FDI. Our results would also apply (suitably modified) to these models.

There is a small empirical literature investigating how foreign investment of multinational firms affects their activity at home or in other locations. While Desai et al (2005) find for a panel of US multinationals that more foreign investment goes along with an expansion of domestic activities, Belderbos et. al (2013), using a dataset of Japanese multinationals, find a negative relationship between activities in different locations, confirming the results of Stevens and Lipsey (1992) for US data. Herzer and Schrooten (2008) find a positive relationship for US data, confirming the findings in Desai et al (2005), and a negative relationship in data for German multinational firms. Thus, regarding the question of whether the assumptions of fixed or flexible supply of the variable factor in our model are more relevant, the empirical literature is divided.[14]

4 Analysis

4.1 The Firm

The firm maximizes the value of second-period after-tax cash-flow minus new equity, i.e.

$$\tilde{V} = -E + \frac{(1-\tau)\Pi + (1-\tau^* - \tau^f)\Pi^*}{1+r} \tag{6}$$

where r is taken as exogenous e.g. determined on the world market (we relax this in an extension below). So, using (4),(5) and(6), the maximand of the firm can be written out explicitly as

$$\begin{aligned} V \;=\; & -(1-\hat{\Delta})(1+r)(1-a)P - (1-\hat{\Delta}^*)(1+r)(1-a^f-a^*)P^* \\ & +(1-\tau)\left[\int_{\hat{\Delta}}^1 (v+\Delta-w)d\Delta - c\left(1-\hat{\Delta}-(M-M^*)\right)\right] \\ & +(1-\tau^*-\tau^f)\left[\int_{\hat{\Delta}^*}^1 (v^*+\Delta^*-w)d\Delta^* - c^*(1-\hat{\Delta}^*-M^*)\right] \end{aligned} \tag{7}$$

where $V = \tilde{V}(1+r)$.The firm's choice variables are $\hat{\Delta}, \hat{\Delta}^* \in [0,1]$ and $M^* \in [0, M_0]$. Throughout, we assume interior solutions; it is a straightforward exercise to show that Propositions 1-4 below extend to the case of corner solutions. Then, the firm's first-order conditions with respect to $\hat{\Delta}, \hat{\Delta}^*$ characterize the acquisition decisions of the firm and can be written as:

$$\frac{v+\hat{\Delta}-w-c'(h)}{P} = \frac{(1-a)}{(1-\tau)}(1+r) \tag{8}$$

$$\frac{v^*+\hat{\Delta}^*-w-c^{*\prime}(h^*)}{P^*} = \frac{(1-a^*-a^f)}{(1-\tau^*-\tau^f)}(1+r) \tag{9}$$

[14] In section 5.4.5. we also consider the case where managerial capacity is a public good withing the firm, which implies complementarity of domestic and foreign activity.

These can be interpreted as standard conditions for investment at home and abroad. The LHS of each expression is the marginal product of the investment. The RHS is a standard expression for the cost of capital. These are equalized at the optimal level of investment. The RHS of the condition for outbound investment reflects the tax due in both countries.

The firm's first-order condition with respect to M^* characterizes the decision of the firm about where to allocate initial management capacity, and is:

$$c^{*\prime}(h^*)(1-\tau^*-\tau^f) = c'(h)(1-\tau) \tag{10}$$

This says that the marginal cost of adjusting management numbers for the MNC is the same in the domestic and foreign country.

4.2 National Optimality

4.2.1 Greenfield Investment

We begin with the greenfield case. We treat the interest rate r and the wage w are independent of both the MNC's decisions and choice of tax system. Given this, national economic welfare can then be measured by just the value of the firm plus domestic tax revenue. (When r, w are not exogenous, this is not the case - see Section 5.2 below). An expression for this can be obtained from (7) by setting $\tau^f = \tau = a = a^f = 0$, (this adds in net tax revenue) and also specializing to the greenfield case by setting $v = v^* = 0$, $P = C$ and $P^* = C^*$. Doing this gives

$$\begin{aligned} W_{N,G} \quad = \quad & -(1-\Delta)(1+r)C - (1-\Delta^*)(1+r)C^*(1-a^*) \\ & + \left[\int_{\hat{\Delta}}^{1}(\Delta - w)d\Delta - c(h)\right] + (1-\tau^*)\left[\int_{\hat{\Delta}^*}^{1}(\Delta^* - w)d\Delta^* - c^*(h^*)\right] \end{aligned} \tag{11}$$

Note that from the perspective of national welfare the benefit of the foreign purchase is reduced by the tax τ^*, but at the same time, the cost of the foreign purchase is reduced by the foreign tax allowances at rate a^*. The first-order condition for a maximum of (11) with respect to $\hat{\Delta}, \hat{\Delta}^*,\ M^*$ can be written as:

$$\frac{\hat{\Delta} - w - c'(h)}{C} = 1 + r \tag{12}$$

$$\frac{\hat{\Delta}^* - w - c^{*\prime}(h^*)}{C^*} = \frac{(1-a^*)}{(1-\tau^*)}(1+r) \tag{13}$$

$$c^{*\prime}(h^*)(1-\tau^*) = c'(h) \tag{14}$$

These compare to the firms' conditions (8),(9),(10). The tax system is said to be *nationally optimal* if the firm's choice of $\hat{\Delta}, \hat{\Delta}^*,\ M^*$ also maximizes $W_{N,G}$.

The conditions for this are as follows. First, comparing (10) and (14), we see that if assumption C holds, for nationally optimal allocation of M^*, we need

$$(1-\tau^*) = \frac{(1-\tau^*-\tau^f)}{1-\tau} \Rightarrow \tau^f = \tau(1-\tau^*) \tag{15}$$

i.e. the deduction rule. On the other hand, if NC holds, choice of M^* is undetermined, and so no restriction is as yet imposed on τ^f.

Second, consider investments. Comparing (8) and (12) for domestic investment with $v = 0$ and $P = C$ implies that national optimality requires

$$a = \tau \tag{16}$$

This is a standard result requiring a cash flow taxation or its equivalent for domestic investment, at any rate of tax for $0 \leq \tau \leq 1$. It is well known that such a tax leaves the cost of capital unaffected, and therefore neutral with respect to standard investment decisions. This result is independent of the size of adjustment costs. Comparing (9) and (13) for outbound investment, national optimality of investment requires

$$\frac{(1 - a^f - a^*)}{(1 - \tau^* - \tau^f)} = \frac{(1 - a^*)}{(1 - \tau^*)} \tag{17}$$

which implies

$$\tau^f = \theta(1 - \tau^*),\ a^f = \theta(1 - a^*),\ 0 \leq \theta \leq 1 \tag{18}$$

This implies that the home country should levy a cash flow tax at any rate θ on the net flows from the foreign country on the outbound investment. Note that since this cash flow tax is applied to net flows, then foreign tax payments are effectively deducted from the tax base; following the literature, we call such a tax a *cross-border cash-flow tax.* But, from (15), θ must be equal to τ for if assumption C holds. So, we have shown:

Proposition 1. *Assume greenfield investment. For national optimality, cash-flow taxes are required on domestic investment i.e. $a = \tau$. In addition, if there is limited managerial capacity, i.e. assumption C holds, sufficient conditions for national optimal acquisition and managerial capacity decisions are: (i) the deduction rule i.e. $\tau^f = \tau(1 - \tau^*)$, and (ii) allowances $a^f = \tau(1 - a^*)$. These two are equivalent to a cross-border cash-flow tax at rate $\theta = \tau$. If adjustment costs are zero i.e. NC holds, τ^f is undetermined, and thus, exemption ($\tau^f = 0$), is one possible optimal rule.*

The intuition for this result is simply one of targets and instruments. There are three targets; efficient choice of M^*, and efficient domestic and foreign asset purchases. The efficient choice of M^* requires the deduction rule i.e. $\tau^f = \tau(1 - \tau^*)$. Given this, the firm can be induced to make nationally efficient domestic asset purchases by setting a cash-flow tax at rate τ, and similarly, can be induced to make nationally efficient domestic asset purchases by setting a cross-border cash-flow tax, also at rate τ.

4.2.2 Acquisition Investment

Now we turn to the acquisition case. National economic welfare can again be measured by just the value of the firm plus domestic tax revenue, which using (7), is now:

$$\begin{aligned} W_{N,A} &= -(1 - \Delta)(v - w) - (1 - \Delta^*)(1 + r)P^*(1 - a^*) \\ &\quad + \int_{\hat{\Delta}}^{1} (v + \Delta - w)d\Delta - c(h) + (1 - \tau^*)\left[\int_{\hat{\Delta}^*}^{1} (v^* + \Delta^* - w)d\Delta^* - c^*(h^*)\right] \end{aligned} \tag{19}$$

Again, the tax system is said to be *nationally optimal* if the firm's choice of $\hat{\Delta}, \hat{\Delta}^*,\ M^*$ also maximizes $W_{N,A}$. The first-order conditions for the nationally optimal choice of $\hat{\Delta}, \hat{\Delta}^*$ are now:

$$\hat{\Delta} = c'(h) \tag{20}$$

$$\frac{v^* + \hat{\Delta}^* - w - c^{*\prime}(h^*)}{P^*} = \left(\frac{1-a^*}{1-\tau^*}\right)(1+r) \tag{21}$$

$$c^{*\prime}(h^*)(1-\tau^*) = c'(h) \tag{22}$$

Note that the managerial efficiency condition is identical to that in the greenfield case. The condition for foreign acquisitions is also identical, recalling that $P^* = C^*$ in the greenfield case.

So, our first conclusion from (22) is that the deduction rule i.e. $\tau^f = \tau(1-\tau^*)$ is also required, as in the greenfield case. Second, comparing (20),(8), and recalling that $P = (v-w)(1-\tau)/(1+r)$ from (2), we see that $a = 0$ is required for nationally optimal domestic acquisitions. This differs from the greenfield case, where $a = \tau$, because the price of the target company, P, is already effectively multiplied by $1-\tau$ because of the capitalization effect. That is, there is no need for an allowance as the tax is capitalized into the price.

Finally, comparing (21),(9), we see that again, any cross-border cash-flow tax at rate θ, *i.e.* where $\tau^f = \theta(1-\tau^*)$ and $a^f = \theta(1-a^*)$, $0 \leq \theta \leq 1$ will ensure nationally optimal foreign acquisitions. We can summarize these results as follows:

Proposition 2. *Assume acquisition investment. Then, the tax rules for nationally optimal acquisition and capacity decisions are identical to the greenfield case, with the exception that no relief on domestic investment i.e. $a = 0$ is now required. That is, as long as C holds, the deduction rule i.e. $\tau^f = \tau(1-\tau^*)$, and allowance $a^f = \tau(1-a^*)$ is required. Again, these are equivalent to a cross-border cash-flow tax at rate $\theta = \tau$ on foreign investment.*

This result is an extension of Proposition 1 of Becker and Fuest (2010) to the case where total management capacity is not fixed ($c, c^* = \infty$), but variable at a cost. If assumption NC applies i.e. fully variable management capacity, then from Proposition 2, the optimal choice of τ^f is undetermined, as in Proposition 3 of Becker and Fuest (2010). Moreover, comparing Propositions 1 and 2 makes it clear that there is no fundamental difference between greenfield and acquisition investment. The crucial issue is whether there is any cost of expanding managerial capacity (assumption C) or not (assumption NC).

A cross-border cash flow tax at the domestic tax rate would be relatively straightforward to implement. The home country would simply need to give relief for any outbound real investment expenditures - whether greenfield or acquisition - and tax the corresponding real inflows. This is equivalent to a R-based cash flow tax on domestic investment, proposed by Meade (1978) and discussed in many subsequent contributions.

4.3 Global Optimality

4.3.1 Greenfield Investment

We begin again with the greenfield case. The difference between national and global welfare in our model is that foreign taxes are costs from a national perspective but not from a global perspective. So, modifying

(11), global economic welfare is measured by:

$$\begin{aligned} W_{G,G} &= -(1-\Delta)(1+r)C - (1-\Delta^*)(1+r)C^* \\ &\quad + \int_{\hat{\Delta}}^{1} (\Delta - w)d\Delta - c(h) + \int_{\hat{\Delta}^*}^{1} (\Delta^* - w)d\Delta^* - c^*(h^*) \end{aligned} \tag{23}$$

The first-order conditions for a maximum of (23) are

$$\frac{\hat{\Delta} - w - c'(h)}{C} = 1+r \tag{24}$$

$$\frac{\hat{\Delta}^* - w - c^{*\prime}(h^*)}{C^*} = 1+r \tag{25}$$

$$c^{*\prime}(h^*) = c'(h) \tag{26}$$

First, comparing (10) and (26), we see that if assumption C holds, for globally optimal allocation of managerial capacity, M^*, we need

$$1 - \tau = 1 - \tau^* - \tau^f \Rightarrow \tau^f = \tau - \tau^*$$

This is the credit rule: the domestic country must give a full credit for foreign taxes paid, and then tax the foreign income at the domestic tax rate. This is because global optimality requires the marginal managerial unit to be taxed at the same rate at home and abroad. If assumption NC holds, of course, no constraint is placed on τ^f.

For domestic greenfield investment, comparing (8) and (24), with $v = 0$, global optimality implies the same condition as national optimality. Hence a cash flow tax with $a = \tau$ is optimal. This is because there is no difference in the expressions for national and global welfare with respect to domestic investment. Since we are considering global welfare, by symmetry, the foreign country should also implement a cash flow tax to ensure optimality of its own domestic investment, so that $a^* = \tau^*$.

Finally, $\tau^f = \tau - \tau^*,\ a^* = \tau^*$ is equivalent to a cross-border cash flow tax at rate $\theta = (\tau - \tau^*)/(1 - \tau^*)$. The key difference between the requirements for national and global optimality in the case of greenfield investment is therefore the tax rate applied to outbound investment; in the former case, it is $\theta = \tau$. We therefore have shown:

Proposition 3. *Assume greenfield investment. For global optimality, cash-flow taxes are required on domestic investment in each country i.e.* $a = \tau,\ a^* = \tau^*$. *In addition, if there is limited managerial capacity, (assumption C) necessary and sufficient conditions for globally optimal acquisition and managerial capacity decisions are: (i) the credit rule i.e.* $\tau^f = \tau - \tau^*$, *and (ii) allowance* $a^f = a - a^*$. *Conditions (i) and (ii) are equivalent to a cross-border cash-flow tax at rate* $\theta = (\tau - \tau^*)/(1 - \tau^*)$. *If there is unlimited management capacity (assumption NC),* τ^f *is undetermined, and thus, exemption* ($\tau^f = 0$) *is one possible optimal rule.*

4.3.2 Acquisition Investment

We now turn to acquisitions investment. At the global level, the opportunity cost of the asset to the multinational firm is not P^*, but forgone revenue $v^* - w$ in the second period. So, modifying (19), global economic welfare is measured by

$$W_{G,A} = -(1-\Delta)(v-w) - (1-\Delta^*)(v^*-w) + \int_{\hat{\Delta}}^{1} (v+\Delta-w)d\Delta - c(h) + \int_{\hat{\Delta}^*}^{1} (v^*+\Delta^*-w)d\Delta^* - c^*(h^*) \tag{27}$$

The first-order condition for a maximum of $W_{G,A}$ are:

$$\hat{\Delta} = c'(h) \tag{28}$$

$$\hat{\Delta}^* = c^{*\prime}(h^*) \tag{29}$$

$$c^{*\prime}(h^*) = c'(h) \tag{30}$$

The first of these - the condition for domestic investment - is the same as the case of national optimality. The second differs from the national optimality case because tax relief in the foreign country is now considered as a transfer with no welfare consequences; this term from (21) is not therefore present. The third condition, for allocation of managerial capacity, is the same as that required for global optimality of greenfield investment.

Not surprisingly, then the implications for taxes are similar. First, as (30) is the same as (26), the credit rule is still optimal $\tau^f = \tau - \tau^*$ as long as assumption C holds. Second, comparing (8) to (28) and using the price formulae (2), we see that $a = 0$ again reflecting the fact that the tax is capitalized into the price of the target firm. By symmetry, then we also have $a^* = 0$. Combining (29) with (9) indicates that global optimality for outbound acquisitions requires

$$\frac{1-a^*-a^f}{1-\tau^*-\tau^f} = \frac{1}{1-\tau^*}$$

Conditional on $a^* = 0$, then the condition is similar to that for national optimality, in (17). That is, the condition is satisfied by a cross-border cash flow tax with rate $\theta(1-\tau^*)$ and allowance $a^f = \theta$, $0 \leq \theta \leq 1$. However, as already remarked, the condition (30) for globally optimal allocation of managerial capacity is that $\tau^f = \tau - \tau^*$ if assumption C holds. Consistency between both conditions therefore requires $\theta = (\tau - \tau^*)/(1-\tau^*)$, exactly as for greenfield investment[15]. We have shown the following:

Proposition 4. *Assume acquisition investment. Then, the tax rules for globally optimal acquisition and capacity decisions are identical to the greenfield case, with the exception that no relief on domestic investment in each country i.e.* $a = 0$, $a^* = 0$, *is now required. That is, as long as assumption C holds, the credit rule i.e.* $\tau^f = \tau - \tau^*$, *and an allowance* $a^f = (\tau - \tau^*)/(1-\tau^*)$ *is required. Again, these are equivalent to a cross-border cash-flow tax at rate* $\theta = (\tau - \tau^*)/(1-\tau^*)$ *on foreign investment. If there is unlimited management capacity (assumption NC),* τ^f *is undetermined, and thus, exemption* ($\tau^f = 0$) *is one possible optimal rule.*

Comparing Propositions 3 and 4 shows that the optimality rules for greenfield and acquisition investment are again very similar; the only difference is that in the acquisition case, no allowance is needed for purchase of domestic assets, as the allowance is already effectively capitalized into the price. In particular, a cross-border cash flow tax system can be found which leads to optimal foreign investment in both cases.

[15] However, with $a^* = 0$, in this case the cash flow tax cannot be applied to flows gross of foreign taxes (since $a^f \neq t^f$).

The implementation of such a tax would be similar to the cross-border cash flow tax described above in the context of national optimality. However, there is one important difference - that the optimal tax rate applied to cross-border cash flows by the home country depends on the tax rate of the foreign country. In a multi-country world, that would imply the rate of tax would need to depend on where the outbound investment took place. While this would be possible in principle, it would invite firms to route outbound investment through a high tax country.

How are these results related to the literature? Becker and Fuest (2010) also consider a cross border cash flow system but they impose the restriction that the tax rate has to be equal to the domestic income tax rate and find that this tax system is nationally but not globally optimal. In our model this would imply $\theta = \tau$, which is also compatible with national optimality (see Proposition 2) but not with global optimality (see Proposition 4). Our results also shed light on the optimality properties of the exemption system discussed by Desai and Hines (2003).

4.4 Reconciliation with Observed Practice

Two possible concerns are that, taken literally, our model predicts (i) that countries should choose cash flow taxes (or their equivalent), and (ii) that unless there are zero adjustment costs, countries should choose either a deduction rule (if they cannot coordinate) or a credit rule (if they can), rather than exemption.

The first prediction appears to be inconsistent with a generally-understood international movement towards an expansion of definitions of taxable profit. However, recent evidence from Kawano and Slemrod (2012) questions this interpretation. Based on information from the International Bureau of Fiscal Documentation over the period 1980 to 2004, they document 433 changes to corporation tax base definitions. Of these 248 broadened the base while 195 narrowed the base. One possible explanation of the lack of enthusiasm for cash flow taxes is that the narrower tax base would require a higher tax rate to raise equivalent revenue, and that this may worsen the problem of profit shifting. We model profit shifting below, but we show that in our model cash flow taxes are still optimal. We speculate that this may be due to institutional constraints on tax setting - for example, due to the provisions of the OECD model tax treaty and, for example, non-discrimination provisions in the EU. Such constraints may make it more difficult for countries following a nationally optimal strategy to introduce a deduction system; without this, then a more constrained choice may move away from cash flow taxation. Below we therefore also model the case of income taxation, where allowances are constrained to be equal to depreciation.

The second prediction appears to be inconsistent with the facts that (i) many countries choose exemption, and (ii) countries that have changed their rules in recent years have tended to switch from the credit to the exemption rule. For example, in a recent data-set based on PwC Worldwide Tax Summaries, out of 37 high-income countries, 19 had an exemption system in 1998, rising to 27 in 2008[16]. None of these countries switched from exemption to a credit or other system during this period.

However, with a small and plausible modification to the model, we can explain *both* these facts. To simplify the exposition, assume that the two countries can coordinate, so that the choice is between credit and exemption, and focus on the case of greenfield investment. Note also that an exemption regime is typically less administratively costly than a credit regime. Evidence of this, was provided, for example, in a consultation document issued by the UK government in 2007 on whether the UK should switch

[16] We thank Johannes Voget for providing us with this data-set.

from a credit system to an exemption system. The UK government stated that "as a system of relieving double taxation, the credit system is inevitably less straightforward for large and medium business than dividend exemption"[17], and claimed that the proposed reforms would deliver "administrative savings for business".[18]

Normalize the administrative cost of the exemption regime to zero, and let $K > 0$ be the administrative cost for both countries of operating a credit regime. Also, specialize the costs functions c, c^* to be quadratic i.e. $c = \frac{\alpha}{2}h^2$, $c^* = \frac{\alpha}{2}(h^*)^2$, so the adjustment cost is fully parametrized by $\alpha > 0$. Now let $W_{G,C}(\alpha)$ and $W_{G,E}(\alpha)$ be the values of world welfare when (a) the credit or exemption regime is in place respectively; (b) the firm is optimizing i.e. conditions (8) ,(9), and (10) hold, and finally (c) given (a) and (b), allowances are chosen optimally to maximize (23). Then, the countries will jointly agree on exemption if and only if

$$W_{G,C}(\alpha) - W_{G,E}(\alpha) \leq K$$

Now, by definition, $W_{G,C}(\alpha) > W_{G,E}(\alpha)$, but also, by Proposition 3, $W_{G,C}(\alpha) - W_{G,E}(\alpha)$ tends to zero as $\alpha \to 0$, because as $\alpha \to 0$, the exemption regime is nearly as good as the credit one. Finally, $W_{G,C}(\alpha) - W_{G,E}(\alpha)$ is continuous in α. This means that there is a unique $\hat{\alpha}$ such that $W_{G,C}(\alpha) - W_{G,E}(\alpha) \leq K$, $\alpha \leq \hat{\alpha}$.

So, when adjustment costs are low enough, i.e. $\alpha \leq \hat{\alpha}$, countries will choose the exemption regime. This allows us to explain the trend towards exemption in the context of our model. Increased globalization means that the cost of moving mobile factors between locations has fallen i.e. falling α. As α falls, a given country is more likely to choose exemption.

5 Extensions

5.1 Profit-Shifting

So far we have not allowed for profit-shifting activity by the MNC. This is an important omission, as there is a substantial body of evidence that multinationals use both transfer prices, and other mechanisms, such as debt finance, to shift profit between jurisdictions (e.g. Clausing, 2003). In this section, we extend the model to allow for transfer pricing, using a specification that is standard in the literature (e.g. Haufler and Schjelderup, 2002). It turns out that, strikingly, for national optimality, the same tax rule that ensures globally efficient allocation of managerial capacity i.e. a cross-border cash-flow tax at rate $\theta = (\tau - \tau^*)/(1 - \tau^*)$ also eliminates the incentives to manipulate transfer prices. An analogous result also holds for national optimality, as long as the costs of transfer pricing manipulation are tax-deductible in some jurisdiction. So, the rules identified in his paper are quite robust.

Transfer prices can be accommodated quite naturally in our framework as follows. We suppose that the parent company, located in the home country, buys the managerial input at price w per unit, but charges the subsidiary w^* per unit of managerial input used. Following a substantial theoretical literature on tax competition with transfer pricing (e.g. Haufler and Schjelderup, 2002, Johannesen, 2010, Becker and Fuest, 2012), we suppose that abuse of transfer pricing i.e. $w^* \neq w$ incurs a cost $\psi(w^* - w)$, which is increasing and convex in the deviation of the transfer price from the market price i.e.

[17] HM Treasury and HMRC (2007), page 3, para 1.4.
[18] HM Treasury and HMRC (2007), page 4, para 1.9.

$\psi(0) = 0,\ \psi'(x), \psi'(-x) > 0,\ x \neq 0,\ \psi'' > 0$. This captures, for example, the cost of resources required to conceal transactions from the tax authorities, or possibly, the expected cost of any fines paid[19]. In some countries, these fines may be substantial e.g. in the US, fines are between 20% and 40% of tax evaded (Eden, Valdez, & Li, 2005). However, we do not observe the subjective probability of detection, so it is hard to meaningfully decompose ψ into concealment expenses and expected fines.

The exact specification of the problem facing the firm depends on whether ψ is deductible from tax, either in the home or foreign jurisdiction. The existing theoretical literature on profit-shifting makes a variety of assumptions here. For example, Haufler and Schjelderup (2000), Johannesen (2010), and Krautheim and Schmidt-Eisenlohr (2011) assume non-deductibility, whereas Swenson (2001), Huizinga and Laeven (2008) and Becker and Fuest (2012) assume it is deductible from the parent's tax liability. In practice, it is reasonable that concealment expenses e.g. the employment of accountants and lawyers would be deductible, but fines or penalties if caught would not be. To cover all possibilities, we adopt the most general specification where fractions γ, γ^* of the cost ψ are deductible from the domestic and foreign tax liability respectively, and $1 - \gamma - \gamma^*$ is not deductible anywhere.

Then we can write firm value as

$$\begin{aligned}
V = & -(1-\hat{\Delta})(1+r)(1-a)P - (1-\hat{\Delta}^*)(1+r)(1-a^f-a^*)P^* \\
& +(1-\tau)\left[\int_{\hat{\Delta}}^{1}(v+\Delta-w)d\Delta + \int_{\hat{\Delta}^*}^{1}(w^*-w)d\Delta^* - c\left(1-\hat{\Delta}-M+M^*\right) - \gamma\psi(w^*-w)\right] \\
& +(1-\tau^*-\tau^f)\left[\int_{\hat{\Delta}^*}^{1}(v^*+\Delta^*-w^*)d\Delta^* - c^*(1-\hat{\Delta}^*-M^*) - \gamma^*\psi(w^*-w)\right] \\
& -(1-\gamma-\gamma^*)\psi(w^*-w)
\end{aligned} \tag{31}$$

The firm maximizes (31) with respect to $\hat{\Delta}, \hat{\Delta}^*$ and M^*, and w^*. The first-order conditions with respect to the $\hat{\Delta}, M^*$ continue to be (8)(10). However, (9) is modified to

$$\frac{(1-\tau^*-\tau^f)\left(\hat{\Delta}^* - w^* - c^{*\prime}(h^*)\right) + (1-\tau)(w^*-w)}{P^*} = (1-a^f-a^*)(1+r) \tag{32}$$

The first-order condition with respect to w^* gives rise to an additional transfer-pricing condition

$$(\tau^*+\tau^f-\tau)(1-\hat{\Delta}^*) = \psi'(1-\tau\gamma-(\tau^*+\tau^f)\gamma^*) \tag{33}$$

The LHS is the overall tax avoided when w^* is raised by one unit, and the RHS is the resource cost of manipulating w^*, taking into account that fractions γ, γ^* of that cost can be deducted from tax in either the home or foreign country. For example, in the special case where $\gamma, \gamma^* = 0$, this reduces to $\psi' = (\tau^* + \tau^f - \tau)(1 - \hat{\Delta}^*)$, i.e. the marginal cost of manipulating the transfer price is proportional to the difference in the statutory tax rates, as in Haufler and Schjelderup (2000).

We now turn to global optimality when w^* is an additional choice variable. For convenience, we focus just on the greenfield case[20]. As the gains and losses from transfer pricing across countries sum to zero, global welfare (23) is modified just by subtracting $\psi(w^* - w)$. So, at the global optimum, $\psi' = 0$, which

[19] For example, suppose that the fine is proportional to $|w^* - w|$ i.e. $\phi\ |w^* - w|$, and the probability of detection is also proportional to $|w^* - w|$ i.e. $\pi\,|w^* - w|$; then the expected fine is $\pi\phi(w^* - w)^2$.

[20] All results are the same in the acquisition case.

implies that manipulation of transfer prices cannot be globally optimal i.e. global optimality requires $w^* = w$. But now note that if the credit rule is used, $\tau^f = \tau - \tau^*$, (33) reduces to $\psi' = 0$ as required. Also note that when $w = w^*$, (32) reduces to (9), and we have already established that (9) is consistent with global optimality when the credit rule holds. To put it another way, the first-best can be achieved by a cross-border cash-flow tax at rate $\theta = (\tau - \tau^*)/(1 - \tau^*)$, even with profit-shifting by firms. The intuition for this is clear: with the credit rule the firm in effect pays tax at rate τ on all its profit worldwide - there is therefore gain to shifting profit.

For completeness, we consider national optimality. With possible abuse of transfer prices, national welfare (11) becomes

$$\begin{aligned} W_{N,G} &= -(1-\Delta)(1+r)C - (1-\Delta^*)(1+r)C^*(1-a^*) \\ &+ \left[\int_{\hat{\Delta}}^1 (\Delta - w)d\Delta + \int_{\hat{\Delta}^*}^1 (w^* - w)d\Delta^* - c(h) - \gamma\psi\right] \\ &+ (1-\tau^*)\left[\int_{\hat{\Delta}^*}^1 (\Delta^* - w^* - \gamma^*\psi)d\Delta^* - c^*(h^*)\right] - (1-\gamma-\gamma^*)\psi \end{aligned} \tag{34}$$

The first-order conditions for national optimality with respect to $\hat{\Delta}, M^*$ continue to be (12), (14). However, (13) is modified to

$$\frac{(1-\tau^*)(\hat{\Delta}^* - w^* - c^{*\prime}(h^*)) + w^* - w}{C^*} = (1-a^*)(1+r) \tag{35}$$

Moreover, the first-order condition for a maximum of (34) with respect to w^* gives rise to an additional transfer-pricing condition which simplifies to

$$\tau^*(1-\hat{\Delta}^*) = \psi'(1-\tau^*\gamma^*) \tag{36}$$

The LHS is again the overall foreign tax avoided when w^* is raised by one unit, and the RHS is the resource cost of manipulating w^*, taking into account that fraction γ^* of that cost can be deducted from tax in the foreign country.

Comparing (33) and (36), then as long as $\gamma + \gamma^* = 1$, i.e. that all resources used to transfer price are deductible from tax *somewhere*, the deduction rule $\tau^f = \tau(1 - \tau^*)$ delivers national optimality, conditional on $\hat{\Delta}^*$ being optimal. Moreover, comparing (32), (35), we see that these two are equivalent if $\tau^f = \tau(1 - \tau^*)$, $a^f = \tau(1 - a^*)$. But, as argued in Proposition 1 above, these two conditions are in turn equivalent to a cross-border cash-flow tax at rate at rate $\theta = \tau$.

So, we can summarize our results as follows:

Proposition 5. *Assume that manipulation of the transfer price is possible. Then:*

(i) For global optimality, cash-flow taxes are required on domestic investment in each country i.e. $a = \tau,\ a^* = \tau^*$*. In addition, whether or not there is limited managerial capacity, necessary and sufficient conditions for globally optimal acquisition, managerial capacity and transfer pricing decisions are a cross-border cash-flow tax at rate* $\theta = (\tau - \tau^*)/(1 - \tau^*)$*.*

(ii) For national optimality, cash-flow taxes are required on domestic investment i.e. $a = \tau$*. In addition, if the costs of transfer pricing are tax-deductible in some jurisdiction i.e.* $\gamma + \gamma^* = 1$*, then, whether or not there is limited managerial capacity, necessary and sufficient conditions for globally optimal acquisition, managerial capacity and transfer pricing decisions are a cross-border cash-flow tax at rate* $\theta = \tau$*.*

Note finally that national optimality cannot generally be achieved if $\gamma + \gamma^* < 1$. If $\gamma = \gamma^* = 0$, for example, as in Haufler-Schjelderup (2000), then from (36), national optimality requires $\psi' = \tau^*(1 - \hat{\Delta}^*)$. From (33), the firm can be induced to follow this rule only if $\tau^f = \tau$, which is not consistent with the deduction rule $\tau^f = \tau(1 - \tau^*)$. In this case, there is a genuine "second-best" tax design problem[21].

Proposition 5 relates to the existing literature as follows. Most theoretical papers on corporate profit shifting assume that foreign source income is exempt from domestic taxation. The focus of these papers is usually on how profit shifting affects nationally optimal corporate tax policy (Haufler and Schjelderup (2000)) or on the role of anti tax avoidance policies (Peralta et al (2006), Becker and Fuest (2012)). There are empirical studies, though, which investigate the role of taxes on foreign source income for profit shifting and find that countries which tax exempt foreign profits from domestic taxation are more vulnerable to profit shifting than countries with tax credit systems (Markle (2012), Maffini (2012)), which is in line with the result in proposition 5.

5.2 An Income Tax

We now consider the case in which each country levies a tax on the full income of the firm. We define this to be a tax on the total income of the firm after deducting costs other than financing costs. In effect, this fixes the rate of allowance. This leaves only the tax rates as instruments that can be set by each government. We assume full relief is available for the cost of depreciation, but no relief is available for the cost, or opportunity cost, of finance. In the context of a two period model, the asset has no value at the end of period 2, and hence the rate of depreciation in that period is 100%. This generates tax relief in period 2 of τ in the home country and τ^* in the foreign country. Assume that the tax on outbound investment receives a depreciation allowance worth $d = \tau^f$. Note that these depreciation allowances are equivalent to fixing the values of the initial allowance as $a = \tau/(1+r)$; $a^* = \tau^*/(1+r)$ and $a^f = \tau^f/(1+r)$. So, plugging these values for the allowances into the firm's first-order conditions (8),(9), we get

$$\frac{v + \hat{\Delta} - w - c'(h)}{P} = \frac{1 + r - \tau}{1 - \tau} \tag{37}$$

$$\frac{v^* + \hat{\Delta}^* - w - c^{*\prime}(h^*)}{P^*} = \frac{1 + r - \tau^* - \tau^f}{1 - \tau^* - \tau^f} \tag{38}$$

[21] This problem could be stated as: given τ, τ^*, find a, a^*, τ^f to maximize national or global welfare, given the induced behavior of the firm. This is a difficult problem to solve, and is beyond the scope of this paper. We conjecture that the second-best optimal tax τ^f will be somewhere between τ and $\tau(1 - \tau^*)$, and it will depend on the degree of responsiveness of transfer pricing to the tax differential $(\tau^* + \tau^f - \tau)$, and the degree of responsiveness of the allocation of h, h^* to the tax wedge $(1 - \tau^* - \tau^f)/(1 - \tau)$.

The firm's first order condition for the allocation of management capacity is unchanged because the costs associated remain fully deductible. Obviously, conditions for national and global optimality are unchanged and are given by equations (12) - (14) and (24)-(26) respectively for greenfield investment, and (20) - (22) and (28)-(30) respectively for acquisitions investment.

It is now clear that with an income tax, it is not possible to achieve a national or global first-best. First, comparing (37) with the conditions for national and global optimality of domestic investment, it is clear that the cost of capital under an income tax (the RHS of (37)) exceeds the cost of capital under the optimality conditions. Consequently, for any positive tax rate, there will be under-investment domestically by the MNC. Second, comparing (38) with the condition of global optimality also indicates that, for any positive tax rate in the foreign country, there will be under-investment relative to the global optimum. A sufficient condition for the national optimum is an exemption system: $\tau^f = 0$. But, if adjustment costs are positive, i.e. condition C holds, national optimality requires $\tau^f = \tau(1-\tau^*)$, and both cannot hold generally.

So, we now investigate the second-best setting of τ^f via a mixture of analytical results and simulations. First, without much loss of generality, we assume that adjustment costs are quadratic i.e. $c(h) = \alpha h^2/2$, $c^*(h^*) = \alpha^*(h^*)^2/2$. We will also focus on the greenfield case and global optimality. Then, the model parameters are $(r, \tau, \tau^*, \ \alpha, \alpha^*, C, C^*)$. First, note that if the are no adjustment costs $(\alpha = \alpha^* = 0)$, then we see, comparing (24),(25) and (37), (38) that (i) generally, the equilibrium cutoff $\hat{\Delta}$ is too high, but cannot be altered by choice of τ^f; (ii) $\hat{\Delta}^*$ is too high, but can be brought down to the first-best level by setting $\tau^f = -\tau^*$ i.e. by giving a subsidy on foreign investment income, a rule even *more* generous than exemption.

What happens when adjustment costs are strictly positive? The previous argument still applies, but now any deviation from the credit rule will cause an inefficient allocation of management capacity between home and foreign subsidiaries. So, we would expect that these two forces would lead to an optimal τ^f generally *lower* than the credit rule, but somewhere *above* exemption if adjustment costs are important enough. It turns out that we can establish this, or at least the first part, in the case of symmetric investments. We will say that the home and foreign investment opportunities are *symmetric* if the set up and adjustment costs are the same $(C = C^*, \alpha = \alpha^*)$. Then, we have:

Proposition 6. *With greenfield investment, and with an income tax, the second-best globally optimal τ^f is equal to the credit rule plus an adjustment factor i.e.*

$$\tau^f = \tau - \tau^* + (1-\tau)A \tag{39}$$

where

$$A = \frac{1}{\alpha^* h^* \frac{dM^*}{d\tau^f}} \left(\frac{r\tau}{1-\tau} C \frac{d\hat{\Delta}}{d\tau^f} + \frac{r(\tau^* + \tau^f)}{1-(\tau^*+\tau^f)} C^* \frac{d\hat{\Delta}^*}{d\tau^f} \right) \tag{40}$$

In particular, if home and foreign investment opportunities are symmetric, then $A < 0$ at $\tau^f = \tau - \tau^*$, and so the second-best optimal τ^f is below the credit rule.

In (40), $\frac{d\hat{\Delta}}{d\tau^f}$ etc. denote the equilibrium responses of $\hat{\Delta}, \hat{\Delta}^*, M^*$ to changes τ^f via (37), (38) and (10), with $d^f = \tau^f$. The intuition for the result is the following. Consider a small cut in τ^f at $\tau^f = \tau - \tau^*$. This cut will have two effects. First, it will tend to increase M^*, foreign managerial capacity. But, because the credit rule is initially in place, the initial allocation of managerial capacity between home and foreign subsidiaries is efficient and so this effect has no first order effect on welfare. Second, it will affect $\hat{\Delta}, \hat{\Delta}^*$, raising the former and lowering the latter. However, it can be shown that the cut increases the number of projects undertaken in the aggregate (i.e. lowers $\hat{\Delta} + \hat{\Delta}^*$) which has a first-order positive effect on global welfare, as the cost of capital is initially too high both domestically and abroad under an income tax.

The following simulations illustrate this result[22]. Figure 1 graphs the optimal τ^f i.e. the value of τ^f that maximizes $W^{G,G}$, subject to constraints (37), (38) and (10). For both $\alpha = 0.5, 0.1$, τ^f lies below $\tau - \tau^*$. One might also expect that the lower α, the lower is τ^f, as in this case, the efficiency loss from cutting it (in terms of the misallocation of managerial capacity) is lower. This is indeed what we see.

Figure 1

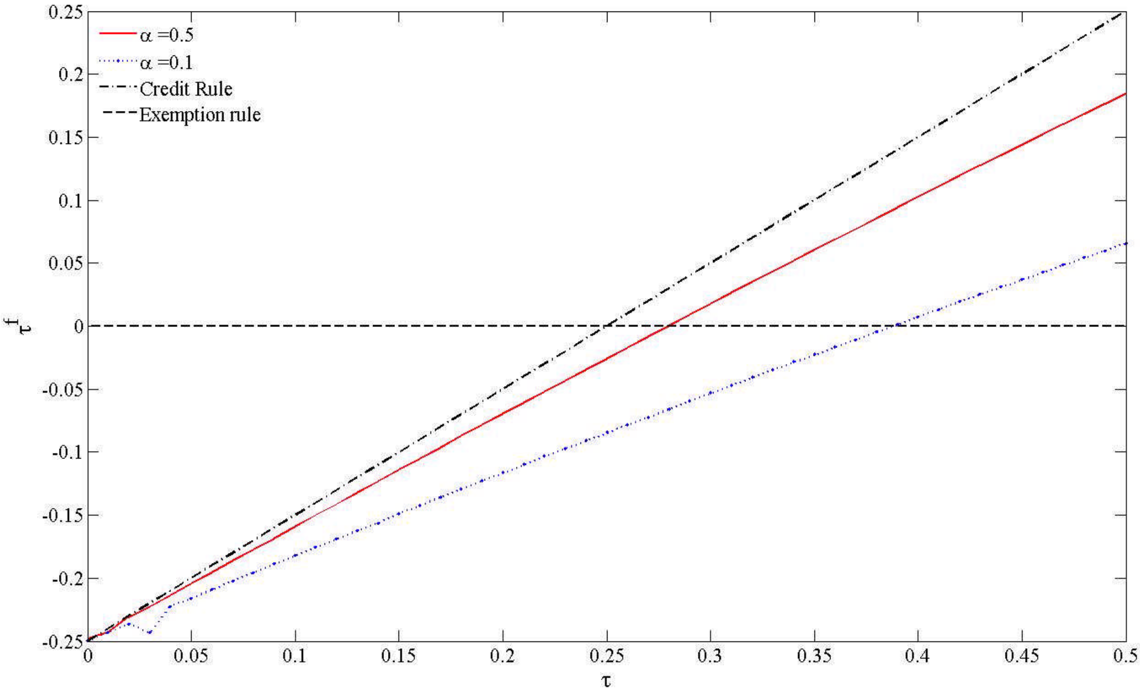


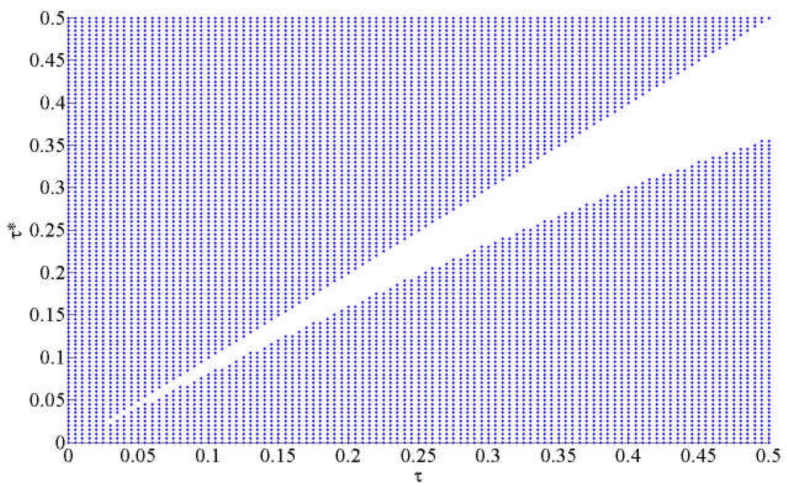
Figure shows the optimal τ^f varying τ for a fixed τ^*=0.2.
Other parameters are $C = C^*$= 0.3

In practice, of course, τ^f is not optimized, but set equal to exemption or credit. So, it is also of interest to ask; for what parameter configurations is credit or exemption the better choice? Figures 2(a),(b) shed some light on this: the shaded area indicates pairs (τ, τ^*) for which credit gives a higher global welfare than exemption. To interpret these figures, note two things. First, the allocation of management capacity is distorted under the exemption system but not under the credit system. Second, the choice between

[22] For all simulations, we assume $w = 0$, $M_0 = 0$, $r = 0.1$, $\alpha = \alpha^*$. Other parameter values are indicated in the notes to the figures.

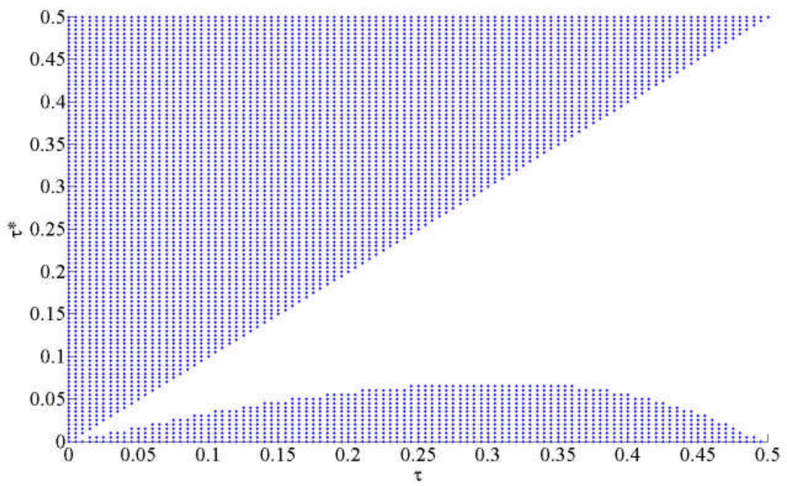
exemption and credit system affects the distortion of the foreign investment decision depends on whether the home tax is higher or lower than the foreign tax.

Figure 2(a): $\alpha = 0.5, C, C^* = 0.3$



Credit weakly dominates exemption in the shaded area.

Figure 2(b): $\alpha = 0.1, C, C^* = 0.3$



Credit weakly dominates exemption in the shaded area.

Whenever the home tax is lower, a switch from exemption to credit will reduce *both* distortions, because it will lower the tax on foreign-source income, and move the foreign project cost $C^* \frac{1+r-\tau^*-\tau^f}{1-\tau^*-\tau^f}$ closer to $C^*(1+r)$. As a result, if $\tau < \tau^*$, credit dominates exemption in terms of global welfare. But when the home tax is higher, things are less clear-cut. Moving from the exemption to the credit system still removes the distortion of management capacity. However, the distortion of foreign investment increases. Therefore exemption can be better than credit in this case, as can be seen in Figures 2(a),(b). Moreover, exemption is more likely to dominate the smaller the parameter α, since a small α implies that the distortion of management capacity caused by the exemption system is relatively unimportant. This is illustrated by the comparison between Figures 2(a) and (b), where α is smaller in case (b).

Finally, the question arises as to whether Proposition 6 requires the assumption of symmetry. In fact, it is required: Figure 3 shows that when the foreign investment projects are relatively less costly than the home ones ($C^* < C$) it is possible that $\tau^f > \tau - \tau^*$ i.e. τ^f exceeds the credit rule. This is consistent with formula (40): when C^* is small, the first term in A dominates, and this will be positive as an increase in τ^f both lowers foreign management capacity ($\frac{dM^*}{d\tau^f} < 0$) and increases the number of domestic projects $\left(\frac{d\hat{\Delta}}{d\tau^f} < 0\right)$. In turn, if A is positive, this implies $\tau^f > \tau - \tau^*$.

Figure 3

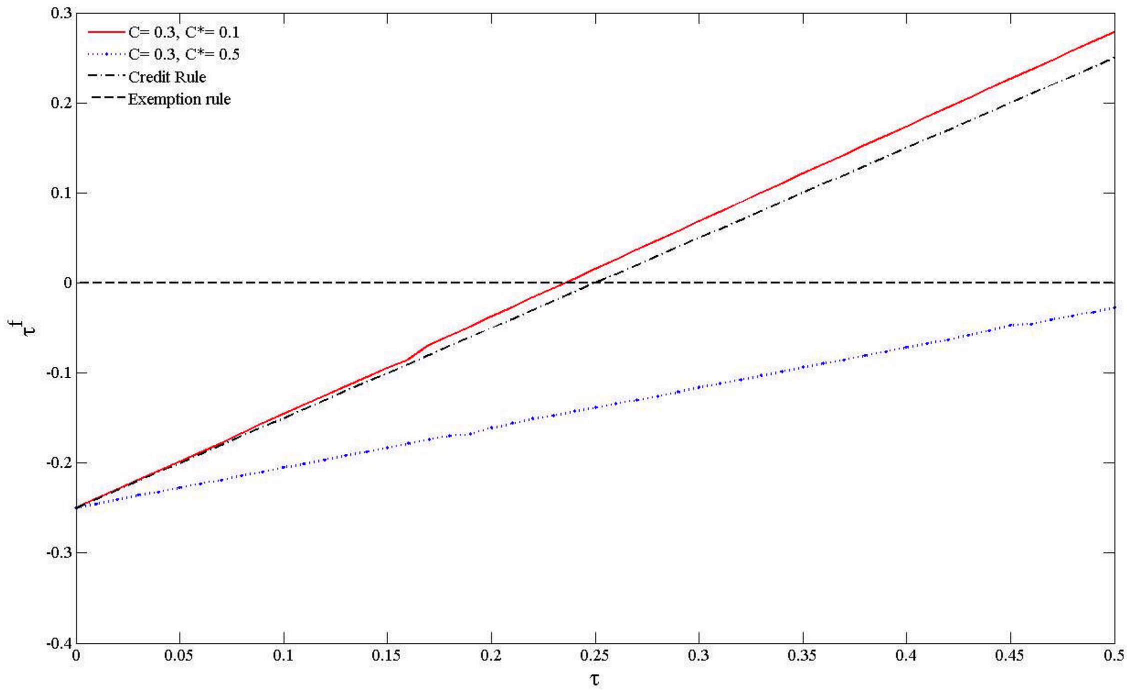


Figure shows the optimal τ^f varying τ for a fixed τ^*=0.2.
Other parameters are: $\alpha = 0.5$.

5.3 Other Extensions

5.3.1 Endogenous Factor Prices

So far we have assumed that the interest rate r and the price of internationally mobile managers w are given exogenously. Assuming that prices of internationally mobile factors are fixed is a standard assumption in the analysis of tax policy in small open economies. This assumption is appropriate for the analysis of national optimality but problematic when it comes to analyzing global optimality. In a previous version of this paper (Devereux et. al., 2013), we endogenize r and w.

This is done following Becker and Fuest (2010), by assuming that households in both countries save, generating a supply of capital, and also supply labour, interpreted as management services. In this setting, changes in $\hat{\Delta}$, $\hat{\Delta}^*, M^*$ cause r and w to change, generating "terms of trade" effects. These effects wash out when global welfare is considered, so Propositions 3 and 4 continue to hold when r and w are endogenized. However, things are different in the case of national optimality if individual countries have a significant impact on these factor prices. In this case the optimal tax policy depends on whether countries are net importers or exporters of capital and management services. The fact that countries may be able to exploit market power in international markets has been studied extensively in the literature[23], so that we do not discuss this issue further here.

5.3.2 Deferral

In practice, most tax systems only tax foreign income when it is repatriated, rather than when it accrues abroad (and when the foreign tax is paid). To analyze how this affects the results in this paper, assume that the foreign subsidiary has retained earnings after foreign tax from previous periods denoted by R^*. Out of this, it uses E^* to finance its foreign investment earning profits of Π^* the following period. Since this does not involve any flow from the home country, we assume that for this investment $a^f = 0$. The remainder, $R^* - E^*$ is repatriated, facing additional tax at rate τ^f due on the grossed up profit so that the parent company receives $(1 - \tau^* - \tau^f)(R^* - E^*)/((1 - \tau^*)$. As before, the firm maximizes the value of second-period after-tax cash-flow minus new equity, i.e.

$$\tilde{V} = -E - (R^* - E^*)\frac{(1 - \tau^* - \tau^f)}{(1 - \tau^*)} + \frac{(1 - \tau)\Pi + (1 - \tau^* - \tau^f)\Pi^*}{1 + r} \tag{41}$$

where r is taken as exogenous. Using (4), (5) and (6), we see that the formula for the value of the firm, (7), continues to hold except that the effective cost of foreign investment falls from $(1 + r)(1 - a^*)P^*$ to $(1+r)(1-a^*)P^* \frac{(1-\tau^*-\tau^f)}{(1-\tau^*)}$. This implies that the firm's first-order conditions for $\hat{\Delta}$ and M^* are unaffected by deferral, but that the condition for , $\hat{\Delta}^*$ becomes:

$$\frac{v^* + \hat{\Delta}^* - w - c^{*\prime}(h^*)}{P^*} = \frac{(1 - a^*)}{(1 - \tau^*)}(1 + r) \tag{42}$$

The cost of capital on the RHS of (42) is independent of τ^f. This is effectively just an application of the "new view" of dividend taxation: investment financed by retained earnings is independent of the tax due on dividends as long as the dividend tax rate is not expected to change, and was pointed out by Hartman (1985). This is because the investment receives tax relief at the same rate as the subsequent return is taxed, as in a cash flow tax.

The first order condition (42) is identical to the condition for national optimality, since the domestic tax does not affect the size of outbound investment. Hence, outbound investment financed by retained earnings abroad is automatically nationally optimal. Global optimality requires a cash flow tax abroad to ensure no distortion to investment decisions; that is, it requires $a^* = \tau^*$.

[23] For surveys of the literature on setting of source-based capital taxes with an endogenous interest rate, see Haufler (2001).

5.3.3 Competition between Acquirers

So far, we have assumed that the home MNC can extract all the surplus from the seller when making an acquisition. However, as stressed by Desai and Hines (2003), there may be several international investors competing for a single product. Assume now that there is a potential acquirer located in the foreign country (the foreign acquirer, FA) who can produce an additional amount $\gamma(\Delta^*)$ from the target Δ^* firm. The FA could be located in a third country without changing the results, at the cost of additional notation. Now, suppose that the price for the target is set competitively i.e. the firm with the largest reservation price buys it and pays the price that the other firm is willing to pay, if that exceeds the reservation price of the seller, $(v^* - w)/(1 + r)$. This will be the outcome of any auction, for example (Dutch, English, first-price, second-price) conducted by the seller - see e.g. Krishna (2009).

The first point to note is that because the national government takes P^* as given, the conditions for national optimality are unaffected. Thus, Proposition 2 continues to hold. However, this is not true for global optimality; now, the global real opportunity cost allowing the MNC to own the firm Δ^* located in the foreign country is $(v^* - w + \max\{\gamma(\Delta^*), 0\}$. Nevertheless, we can show that Proposition 4 extends to this case (Devereux et. al., 2013).

The key to this extension is that the price of the asset is set competitively. If the seller can extract some of the surplus from the MNC *when there is no other potential buyer*, a kind of "hold-up" problem is created; from a global point of view, the asset is too expensive for the MNC buyer, and so acquisitions will be inefficiently low under cross-border cash-flow taxation. This point is also made in Section 3.3 of Becker and Fuest (2010), and so we do not investigate it formally here. From a national perspective, conditional on the foreign acquisition taking place, then a higher τ^f reduces the price the acquirer is willing to pay, implying that the additional tax is exported to the foreign seller.[24]

5.3.4 Spillovers

So far, we have ignored positive spillovers - demonstration effects, increased competition, worker training, exports etc. - for residents of the host country from FDI. However, the FDI literature emphasizes that they can be very significant. Since such spillovers are often cited as being one of the main reasons countries want to attract MNC investment, this is an important omission.. Furthermore - although there is much less evidence on this - there may be differences in spillovers between greenfield and acquisition[25]. One way to internalize these positive spillovers is for the host country to explicitly subsidize investment (see e.g. Pflüger and Südekum, 2012). However, such explicit subsides may not always be possible (for example, they may not be consistent with EU state aid rules).

Note that the rules derived above for national optimality are unaffected by spillovers, given that they accrue entirely to foreign residents. We therefore focus on global optimality. Here, we briefly show that, even in the absence of such explicit subsidies, there is sufficient flexibility in the tax system to achieve global optimality when spillovers are present.

The natural way to introduce spillovers to this setting is to suppose that the there is some external benefit, $b(1 - G^*(\hat{\Delta}^*))$, to foreign residents from the total volume of investment $1 - G^*(\hat{\Delta}^*)$ in the foreign

[24] See our earlier working paper, Devereux et. al. (2013) for a formal treatment.

[25] The different spillover channels of FDI identified in the literature (demonstration, increased competition, worker training, backward and forward linkages,exports), do not typically distinguish between the two modes of FDI (e.g. Crespo and Fontura, 2007). The only empirical evidence that we are aware of that allows for different effects of the two modes is a study of the Czech Republic (Stancik, 2010).

country. This could differ between greenfield and acquisition investment, in which case we denote the external benefit as b_G and b_A. Consider the greenfield case first. Adding this term to (23), we see that (25) is modified to

$$\frac{b'_G + \hat{\Delta}^* - w - c^{*\prime}(h^*)}{C^*} = 1 + r \tag{43}$$

Now set $\tau^f = \tau - \tau^*$, to ensure efficient allocation of managerial capacity, and, from Proposition 3, let $a^* = \tau^*$, $a^f = \tau - \tau^* + s_G$ in the condition (9) determining the firm's foreign investment. This gives

$$\frac{\hat{\Delta}^* - w - c^{*\prime}(h^*)}{C^*} = \frac{(1 - \tau - s_G)}{(1 - \tau)}(1 + r) \tag{44}$$

Comparing (43),(44), it is then easily seen that in the greenfield case, the firm can be induced to internalize the investment spillover if $s_G = \frac{b'_G(1-\tau)}{C^*(1+r)}$. A similar argument in the acquisition case shows that the required additional allowance is $s_A = \frac{b'_A(1-\tau)}{P^*(1+r)}$. So, when allowances can be optimized, there is enough flexibility in the tax system to internalize spillovers. But, this does require a deviation from cross-border cash-flow taxation, in the direction of subsidizing outward investment.

6 Conclusions

This paper has analyzed the national and global optimality of taxes on foreign source income of multinational firms. We start from the observation that the recent literature on the taxation of foreign profits makes different assumptions regarding the corporate tax system under consideration, the impact of foreign investment on domestic economic activity and the type of foreign investment - investment in immobile assets and investment in mobile capital. The main finding of the analysis is that the standard results regarding the optimal taxation of foreign source income - the national optimality of the full taxation after deduction system and the global optimality of the tax credit system - also hold in a model that combines investment in immobile assets and mobile capital, provided that two conditions hold. Firstly, the corporate tax is a cash flow tax, with full deductibility of all capital expenses. Secondly, more foreign investment reduces domestic investment.

If the second condition does not hold and domestic investment does not decline as a result of more foreign investment, the exemption system leads to optimality, but any other tax on foreign source income (provided it is not confiscatory) does so as well. If the first condition does not hold because either acquisition expenses or capital costs for greenfield investment are not fully deductible, the optimal tax on foreign source income changes. In some cases, none of the standard regimes lead to either national or global optimality.

Our approach has been to consider the optimal taxation of foreign source income in a traditional setting in which the residence of the investor is immobile and in which the costs of administering a tax on foreign source income are not too high. Relaxing either of these conditions could create a situation which makes the exemption more favorable. However, if the mobility of all elements of a multinational company are high enough, then neither residence- nor conventional source-based taxation may be optimal, even under a cash flow tax. In such circumstances, the optimal approach may be to levy a tax on income on a destination basis, that is in the location of sales which are likely to be less mobile.[26]

[26] For an analysis of a destination-based tax, see Auerbach and Devereux (2013).

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A Appendix: Proof of Proposition 6

(i) Differentiating $W_{G,G}$ in (23) with respect to τ^f, bearing in mind that $\hat{\Delta}, \hat{\Delta}^*, M^*$ depend on τ^f, and using $a^* = \tau^*/(1+r)$,we obtain

$$\begin{aligned} \frac{dW_{G,G}}{d\tau^f} &= -\left(\hat{\Delta} - w - c'(h) - (1+r)C\right)\frac{d\hat{\Delta}}{d\tau^f} \\ &\quad -\left(\hat{\Delta}^* - w - c^{*\prime}(h^*) - (1+r)C^*\right)\frac{d\hat{\Delta}^*}{d\tau^f} \\ &\quad +\left(c^{*\prime}(h^*) - c'(h)\right)\frac{dM^*}{d\tau^f} \end{aligned} \tag{45}$$

Using (37) and (38), this can be re-expressed as

$$\begin{aligned} \frac{dW_{G,G}}{d\tau^f} &= -\frac{r\tau}{1-\tau}C\frac{d\hat{\Delta}}{d\tau^f} - \frac{r(\tau^*+\tau^f)}{1-(\tau^*+\tau^f)}C^*\frac{d\hat{\Delta}^*}{d\tau^f} \\ &\quad +\left(1 - \frac{1-\tau^*-\tau^f}{1-\tau}\right)c^{*\prime}(h^*)\frac{dM^*}{d\tau^f} \end{aligned} \tag{46}$$

Setting (46) equal to zero and rearranging, we get (39),(40) as required.

(ii) Now evaluate (40) in the symmetric case i.e. where i.e. $\alpha = \alpha^*, C = C^*$, also imposing the credit rule $\tau^f = \tau - \tau^*$. We get

$$A = \frac{1}{\alpha^* h^* \frac{dM^*}{d\tau^f}}\frac{r\tau}{1-\tau}C\left(\frac{d\hat{\Delta}}{d\tau^f} + \frac{d\hat{\Delta}^*}{d\tau^f}\right) \tag{47}$$

We now show that

$$\frac{dM^*}{d\tau^f} < 0,\ \frac{d\hat{\Delta}}{d\tau^f} + \frac{d\hat{\Delta}^*}{d\tau^f} > 0 \tag{48}$$

Then, it follows from (40) that $A < 0$, and so from (39) that $\tau^f < \tau - \tau^*$ as required.

(ii) From (37), (38) and (10), using $d^f = \tau^f$, and the the assumption of quadratic c, we can write the first-order conditions for the firm's choices as:

$$v + \hat{\Delta} - w - \alpha h = \left(\frac{1+r-\tau}{1-\tau}\right)C \tag{49}$$

$$v^* + \hat{\Delta}^* - w - \alpha^* h^* = \left(\frac{1+r-\tau^*-\tau^f}{1-\tau^*-\tau^f}\right)C^* \tag{50}$$

$$\alpha h(1-\tau) - \alpha^* h^*(1-\tau^*-\tau^f) = 0 \tag{51}$$

Totally differentiating this system, imposing symmetry i.e. $\alpha = \alpha^*, C = C^*$, and $\tau^f = \tau - \tau^*$, and recalling that h, h^* depend on $\hat{\Delta}, \hat{\Delta}^*, M^*$ via (3), we get:

$$\begin{pmatrix} 1+\alpha & 0 & -\alpha \\ 0 & 1+\alpha & \alpha \\ \alpha(1-\tau) & -\alpha(1-\tau) & -2\alpha(1-\tau) \end{pmatrix}\begin{pmatrix} d\hat{\Delta} \\ d\hat{\Delta}^* \\ dM^* \end{pmatrix} = \begin{pmatrix} 0 \\ \frac{rC^*}{(1-\tau^*-\tau^f)^2} \\ \alpha h^* \end{pmatrix} d\tau^f \tag{52}$$

Then, from Cramer's rule, we get

$$
\begin{aligned}
J\frac{d\hat{\Delta}}{d\tau^f} &= \begin{vmatrix} 0 & 0 & -\alpha \\ Z & 1+\alpha & \alpha \\ \alpha h^* & -\alpha(1-\tau) & -2\alpha(1-\tau) \end{vmatrix} = \alpha^2 Z(1-\tau) + \alpha^2(1+\alpha)h^* \\
J\frac{d\hat{\Delta}^*}{d\tau^f} &= \begin{vmatrix} 1+\alpha & 0 & -\alpha \\ 0 & Z & \alpha \\ \alpha(1-\tau) & \alpha h^* & -2\alpha(1-\tau) \end{vmatrix} = -\alpha^2 Z(1-\tau) - \alpha^2(1+\alpha)h^* - 2\alpha(1+\alpha)Z(1-\tau) \\
J\frac{dM^*}{d\tau^f} &= \begin{vmatrix} 1+\alpha & 0 & 0 \\ 0 & 1+\alpha & Z \\ \alpha(1-\tau) & -\alpha(1-\tau) & \alpha h^* \end{vmatrix} = (1+\alpha)^2\alpha h^* + (1+\alpha)\alpha(1-\tau)Z > 0
\end{aligned}
$$

where $Z = \frac{rC}{(1-\tau^*-\tau^f)^2}$, and where J is the determinant of the Jacobian of the system (52), and $J < 0$ from the second-order conditions to the firm's problem. So, $\frac{dM^*}{d\tau^f} < 0$, as required. Moreover, it is then easily checked that

$$J\left(\frac{d\hat{\Delta}}{d\tau^f} + \frac{d\hat{\Delta}^*}{d\tau^f}\right) = -2\alpha(1+\alpha)Z(1-\tau) < 0$$

implying that $\frac{d\hat{\Delta}}{d\tau^f} + \frac{d\hat{\Delta}^*}{d\tau^f} > 0$ as required. □